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ABSTRACT

The purpose of the study presented in this document is to further knowledge about student teacher development contexts during field experiences. The aim is to understand the role of the mentor teacher, the classroom structure and processes, and student teacher content knowledge in the development of a mathematics teaching repertoire. This research used data gathered during the first year of a three-year study. Three student teachers were followed during their second, third, and fourth years in a four-year teacher education curriculum. Findings suggest that subject matter mentoring does not lead to better teaching. Stages of student teacher development may impinge on the ability to understand and focus on subject matter. Student teacher commitment to the learning-teaching experience as well as the relationship with the mentor remain important aspects of the practicum. Contains 22 references. (ASK)

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Student teachers' practices in primary school mathematics

Paper presented at the AERA annual meeting
San Diego, April 14th 1998

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The purpose of the study presented herein is to further our knowledge of student-teacher development contexts during field experiences. More precisely its aim is to understand the role of mentor teacher, the classroom structure and processes, and also that of student-teacher's content knowledge in the development of their repertoire in the teaching of mathematics.

Perspectives and Theoretical Framework

Recent reforms in teacher education have put great emphasis on practice settings. In the Province of Quebec for instance, a fourth year was added to B.Ed. teacher education curriculums and a minimum of 700 hours must now be spent in school-based activities. Concurrently, provisions have been made so that school teachers can play a more important role in mentoring future teachers. However, research in the field of teacher education has consistently reported that learning from field experiences is far from being unproblematic (Zeichner, 1987). The general context of field experiences (Zeichner, 1993) and the difficulties faced by the associate teacher or mentor and the university supervisor seem to impose important limits to the so-called experience of « reality ».

Firstly, researchers have often singled out the problems associated with the role of mentor teacher (Martin, 1997). Crucial to this study, Collison (1995) noted that mentors and mentees

tended not to talk about the curriculum, the subject matter knowledge and child learning. These findings are of great importance, since we know from Calderhead (1987 : 274) that *« when a teacher and tutor were communicating different signals, the teacher communication was not surprisingly more willingly received. »* Secondly, although some studies (McIntyre, 1984) have contended that supervisors play an important role in helping student-teachers reflect on their practice, Richardson-Koehler, (1985) has emphasized the complexity of having to appreciate a student-teacher's practice, which may well have been modelled on the mentor's. Recently, Borko and Mayfield (1995) have also pointed out that university supervisors very seldom have the subject knowledge academic background that could help them focus on curriculum issues or on child learning in specific areas of the curriculum.

Thirdly, in keeping with this perspective, which is concerned with the development of teaching in a specific subject area, there is a growing concern about what Shulman (1986) has coined as the « missing paradigm »; the idea that teachers should know something about the content they are teaching. In the USA, many scholars have gravitated around Shulman. In the UK, a similar interest can be found in the studies of Bennett and Carré (1993) and Maynard (1996). Some authors (Voigt, 1985 ; Brown and Borko, 1990) have suggested that this knowledge of subject matter and about how children learn and understand specific ideas and skills contribute to shape how teachers understand the curriculum, frame and structure the content to be taught and finally, how they tailor their responses toward children.

More recently, Bennett and Turner-Bisset's study (1993) has been aimed at cross-examining these findings on student teacher practices. They have noted that students who taught at consistently higher levels of competence than other students had high levels of appropriate content knowledge. However, although we know that learning is situated (Lave, 1988), we do not know how the practices observed are related to the resources of the context,

particularly the school mentor's expectations and practice. Although studies from classroom ethnography (Woods, 1978) and from classroom ecology (Doyle, 1983) have suggested that the classroom structure and the pupils may create fields of action for practice and learning, we have few studies that have taken into account these aspects of the sites where student-teachers learn.

What happens when the student teacher crosses the school-university boundary during field experiences? What happens if neither the mentor nor the tutor is sensitive and careful about the curriculum component of teaching? What happens when the student-teacher is faced with the contexts and constraints of the field, particularly those that entail being in someone else's classroom (Martin, 1997), that is, a classroom where children's tasks have previously been structured by the associate teacher; a teacher who certainly has his or her own views on teaching and learning teaching? Is it how the effects of teacher education are "washed out by school experience" (Zeichner et Tabachnick, 1981; Brown et Borko, 1992)? This is the type of question this study is investigating.

Method and Context of the Study

This paper concerns the data gathered during the first year of a three-year study (from fall-96 to winter 1999). The methods of this study focus on the examination of how student teachers develop, over-time a repertoire of practice in the teaching of mathematics and how this development is related to the context and to their knowledge of the subject matter. The modes of inquiry are derived from Yingers' (1986) contention that the study of interactive teaching should comprise three simultaneous approaches : a detailed analysis of student-teachers' behaviors, an inquiry into their intentions and motives and an examination of the context.

Three student teachers have been followed during their second, third and fourth year of a four-year B. Ed. teacher education curriculum. Usually, this B.Ed. program assigns four different school-based experiences (see Appendice 1). During the first year, student-teachers spend ten days in school ; they spend 20 days during the second year, 40 days during the third and finally 110 days during the fourth year. However, in 1996-1997 (year 1 of the study) the three student teachers involved attended an « experimental » practicum. In 1997-1998, year 2 of the study, they attended the « regular » practicum, and will continue to do so during their final year. The purpose of the experimental practicum was to put them in the same context ; working with the same group of children age 12, and mentored by the same teacher and supervisor. Together, they worked in co-operation with the mentor when planning the mathematic activities for the children, although they taught the class on a rotation basis. Furthermore, they attended their peers' lessons , through a two-way mirror,.

In 1996-1997, two types of data were being gathered, videotapes and audiotapes. Firstly, videotapes were used to record the student-teacher's practices, as well as the contexts of these practices. Our first task was to adapt the classification created by Bennett and Turner-Bisset's (1993) who studied student-teacher practices in the UK. The system differentiates two broad categories of student teacher interventions : « Mathematics » for those concerned with the content taught and « Management » for the ones involved in classroom management. Through a constant interplay between our data and their original classification, we reviewed the description of the four levels of « Mathematics » interventions.

Figure 1 approx here (see Appendice 2)

Then, our second task was to visualize and understand how student-teachers share their teaching interventions and time between the two categories. Our third task was to discern the levels at which they were teaching mathematics. The coding task was undertaken by a research

assistant and I. We reviewed the videotapes and we cross-examined our codification. On a few occasions, we had to consult with the mentor in order to further understand the practice being used. The purpose of this was to determine the levels of competency at which each student-teacher teaches, in order to be able to understand if, how and why it develops overtime.

Secondly, planning and debriefing sessions between the mentor and the student-teachers, as well as some semistructured interviews about the videotapes and the lessons taught were audiotaped ; they provided access to the motives, knowledge and reflections of the student-teachers and are considered to be a relevant way of triangulating the videotapes.

Coaching provided by the mentor was used to understand the observed student-teachers' practice. It also served as a relevant means for assessing the student-teachers' knowledge about mathematics and mathematics teaching. Conversations were also a relevant data which contributed to study of the content and the process of mentoring.

The data gathered last year spanned over seven months; it comprised seven 2 hour videotapes for each student-teacher and a total of approximately fifty hours of transcribed conversations and interviews. In this presentation, we will present detailed data which concerns one student-teacher, Josée.

Results of the Study

Josée's has a sound background in mathematics. She has a very good academic record; during conversations with the mentor, she demonstrated her awareness of the concepts she was teaching. In addition, during the summer holidays, Josée works as a lifeguard. Energetic and swift, she could communicate her presence to children and how to make, justify and manage tough decisions.

A first glance at Josée's intervention profile gives an insight into her teaching skills (see appendices).

Firstly, the overall share of interventions between mathematics and classroom management suggests that Josée is capable of managing classroom control in a way that spares adequate time for subject-matter teaching. There is an understandable tendency to spend a few minutes of classroom management whenever lessons begin or end. Furthermore, classroom management interventions occur most often during format transitions, when pupils need a bit of help... to settle into the new format.

Secondly, Josée teaches at levels one and two, most of the time.

Thirdly, it is not clear from the graphs, if Josée's interventions improved in quality over the seven-month period. As a matter of fact, one could also claim that Josée's ability to teach mathematics had decreased! However, this claim would not withstand a more subtle analysis that would take into account the content taught and the type of learning activity.

Indeed, there are a few things these graphs fail to show about Josée's teaching.

Firstly, they do not divulge a great deal about the complexity of the classroom management context she had to contend with. For instance, we can observe that the children did not threaten Josée's program of action in a such way that she would not have been able to focus on the content she was teaching. However, we do not know how the children's social skills or the social structure of the classroom eased Josée's task. We are unaware if Josée had to work hard in order to rally the children into her own program of action.

Secondly, along the same line of thought, the graphs do not provide any clues as to the context that might have structured Josée's mathematics intervention. For instance, how do we

explain that she teaches at level 3 during the first session in October (part 1) and merely reaches level 2, two months later, in February (part 1)?

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Appendice 3 approx. here.

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For instance, the April 9th Part 2 graph shows a 20-minute segment, where Josée teaches at level 1 and then, a few minutes later, she enters a segment where she teaches at level 2 and even reaches some level 3 peaks. How can this be explained?

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Appendice 4 approx. here.

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Mainly, we need a better understanding of the tasks that the children and Josée had to carry out. During their mentoring conversations, the mentor and Josée discussed extensively this activity, its objectives and how it could unfold or could have unfolded, etc. A prolonged engagement on the site, with the same classroom, makes it possible to compare this activity with different and similar-type activity formats that occured during other lessons.

During the first segment, the children were playing Stock Exchange in a teamwork format; they threw dices, applied the results to the stocks they had and « drew up a balance of their portfolio.». During this segment Josée's task was to help the teams manage the game; since she was the « acting bank manager », she also checked the evolution of the children's portfolios. Her task was mainly technical. At .46, Josée made a shift in the activity from a play format to a whole class discussion. Josée's task became more complex. She had to help the children construct their understanding of positive and negative numbers, inferring from the game

experience they had had. She also had to help them make links with other activities or situations they know that use negative and positive numbers. She also had to manage a format, (the whole class discussion), which often generates various forms of child participation, thus putting more pressure on classroom management.

When all the lessons taught by Josée are put together, one can suggest a few more temporary hypotheses about her practice as it appears on the graphs.

Firstly, the mathematic level of the whole activity sometimes handcuffs the student-teacher within a definite level of teaching. In other words, one cannot always teach at level 3 or 4; an outstanding teacher also has to teach at level 1.

Secondly, on the other hand the mathematic « intelligence » of an activity might not be well represented through separate interventions, as we are attempting in this study. One still has to take into account the wholeness of any lesson.

Finally, it is still very difficult to measure a particular practice, since this practice is always a reaction to an external situation. As Janvier once put it « the complexity of a particular piece of knowledge can be measured either by the complexity of the subject's production or by the set of parameters that are needed to trigger its production ». Therefore, when one wants to appreciate Josée's practice, one also has to consider the complexity of the context to which she was reacting.

The Mentoring Process

In addition to the classroom context, there is another important factor which is thought to contribute to student-teacher practice; it is the quality of the mentoring process. In this study, Marie, the classroom teacher who mentored the student-teachers during the experimental first

year, was chosen because of her well-known preoccupation and dedication for the content she teaches, particularly mathematics. She believes that in order to teach math, one has to know the concepts and how children learn them. Her belief is that in order to succeed in student teaching, students must address the subject knowledge and she considers that her role as a mentor is to help them understand the subject knowledge.

To understand the role of the mentor, we focussed on two broad questions throughout our analysis of the conversations between the mentors and the mentees :

1- What aspect of subject knowledge was mentored during this field experience; pedagogical content knowledge or general pedagogical knowledge or practical knowledge?

Pedagogical Content Knowledge

Ways of representing a specific subject, in order to make it accessible to pupils (Maynard, p.38)

As expected, Marie, the mentor, often discussed or queried about the content to be taught. Typically, she would use the curriculum or existing material as entries. For instance, when introducing fractions, she would look at the activities Josée had in mind or had prepared; together with the other mentees, they would then research into existing material to find other types of activities. Marie would comment on them, raising issues stemming from the various meanings of fractions, to the respective value of using the « pie metaphor » or the « rectangle » in order to teach fractions. She would talk about the concept to be taught and would stress the importance of using the appropriate mathematic lexic when talking to children. At another time, the mentees would gather and go through the problems the children would have to do. Then Marie would build on their difficulties, to shed light on children's understanding and ways of solving problem. She would then devise what she called the « pedagogical intentions » that

should be the preoccupation of student-teachers when they teach any particular aspect of the curriculum and use specific material.

At the end of the first evaluative-conversation, the way Marie summarized her comments to Josée about her first lesson, portrays Marie's concern for content.

M : « *if you keep having in mind the content your teaching, in order to master it, and if you try to make the children talk a little bit more, it will be very good...* »

J : « *but sometimes, I don't have any questions to ask them....*»

M : « *well then, if you don't have any questions, you can't make them talk about the content or put them into action; you must think about that when planning your lesson...* »

J : « *I question them, when questions come through my mind ...* »

M « *Well, suppose... when you were presenting the various geometrical figures, you were the one who was providing the information, you provided lots of information...* »

J « *Ok!...* »

M « *You could have gathered some information from the children; looking for what they see about the figures...* »

J « *Well, from the start, I was not confident enough; I was afraid of what they could bring forward. What would I do with all that; I was afraid to be speechless. I was afraid to take chances...* »

M « *You must take chances...* »

J « *I asked questions when I was sure; when I knew I was really sure.* »

General Pedagogical Knowledge

Knowledge about teaching and pupils, which is not subject specific.

Another aspect of Marie's mentoring concerns how she mentors general pedagogical knowledge. Marie will seldom focus on ideas and principles that target the overall structure of a lesson. Instead, she will concentrate on ideas and principles that concern the « how to help individual children ». For instance, she will often stress the importance of having pedagogical intentions when initiating a discussion with a child; she would explain to Josée about the need to be able to anticipate children's answers and questions when dealing with concepts; when Josée asked the children not to look at the tangram answer key, Marie challenged her afterwards and raised the possibility that the children were actually using the answers as a way into the problem solving process.

One event might illustrate this aspect of Marie's mentoring : it happened during Josée's first lesson. Josée had planned a thirty-minute seatwork format that would follow a whole class lesson. She had choosen problems that children would have to solve; she organised the work. When the seatwork began, Josée sat down at her desk, leaving pupils to work alone. After 2 to 3 minutes, the children began asking for help. Josée replied that they should work to find the answers on their own. She said she had just done that for herself the day before and that it was now their time to try it. One child replied that Marie never did that. Clearly, Josée had not only to learn ways of helping children during a seatwork format, but she also had to find another way to see the usefulness of seatwork and see how she could develop a personal way of dealing with it. On that day, a few minutes after this pedagogic shortcoming, Marie came into the room and began working with the children. Josée joined in. Afterwards, they discussed the issue and never again did the videotape show any of the three student-teachers sitting at their desk during seatwork. Marie's mentoring addressed this type of student-teacher practice, not only on the

cosmetic aspect of being seated in front of them, but also the deeper aspects, such as the importance and way of questioning pupils, anticipating their responses and building on them.

Practical Content Knowledge

How to organise and manage the teaching of a practical activity

When we look back on all the conversations, there are relatively few excerpts that relate with this third aspect of subject mentoring; which is about the practical aspects of teaching. However, when the issue was raised it was addressed both by Josée and Marie. Sometimes, Josée would express her concerns and question Marie. Sometimes, Marie would deal with the practical aspects in conjunction with the material : together with the student-teachers they would rehearse the lesson, while trying the material or doing the problems. In other cases, Marie would often offer ready-to-use scripts, in order to convey her practical knowledge. For instance, she would speak out the words she would use in reality using the appropriate intonation : *« ask him : « **what would happen if you had ten butterflies instead of twenty**? »*. A variety of aspects were dealt with : they could concern how the workshops would work, for instance, if the children would move from one table to the other, leaving the material in place or the other way around. They also concerned the best way to make teams, the importance of using appropriate material, in order to draw geometric figures, or the idea of sending children in front of the class to illustrate fractions.

2- What were the demands and constraints of subject mentoring?

This study was designed to optimize the subject-matter component of this experimental practicum. The students knew we were focussing on learning how to teach mathematics; the mentor was dedicated to teaching this subject matter. However, there seemed to exist three other « forces » that tended to draw away the mathematic focus : personal commitment, the « human

side » of the practicum and student-teacher immediate needs. Although they are fragile hypotheses at this step of the study, it may be interesting to emphasize them, since they represent horizons which are relevant for the analysis of the data.

Firstly, although the student-teachers were willing to participate in this study, they often compared their « experimental » setting to those of their fellow students engaged in the regular design of the teacher education program. They sometimes felt they lacked the « extended immersion » in the classroom. Midway through the practicum, they were less enthusiastic about the work to be done : planning sessions, attending their peers' lessons from the other side of a mirror, reviewing their videotapes and writing a short analysis of their practice. They would have liked « more pupil contact » and less work with material, videotapes, conversations, ... all things that seemed too « theoretical » and .. booring to them. They wanted action! They would have liked less reflection about the curriculum, less planning, less work with material, etc. At the same time, since the « experimental practicum » was set in a university laboratory instead of a « normal » school, the student teachers did not feel the professional culture that would have scaffolded their involvement. Instead, since they remained in their own student environment, they tended to behave like students.

Secondly, it could be that the mentor did not provide enough freedom for student-teacher trial and error. In retrospect, Marie found herself a bit more directive than she should have been about what the student-teachers were doing with « her » pupils. At the time, her assertion was that, since the « experimental practicum » happened one afternoon each week after which she had to be back in school with the children for the rest of the time, it would be reasonable for the student-teachers to do what she wanted them to do. Therefore, she had a tendency to give the

« contracts » they had to carry out. It could be that the practicum was not empowering enough! Marie also felt the student-teachers' lack of motivation and commitment towards their tasks, such as with missed appointments or planning tasks not done on time. Furthermore, collegiality among student-teachers was not straightforward. There happens to be some tensions between them that complicated the mentoring relationship. When meeting with student-teachers, Marie was aware she had to split her concerns between mentoring the subject matter on the one hand and the relationship among the four of them, on the other. In other words, she could not focus solely on subject mentoring; sometimes she had to downplay relevant subject matter issues, in order to maintain the learning relationship.

Thirdly, by focussing more on the subject matter issue than on general pedagogical knowledge pertaining to whole-class management, Marie's mentoring did follow the design of the « experimental practicum » but, possibly, did not address student-teacher immediate needs! As Fuller's (1969) developmental model suggests, perhaps the student-teachers needed more general knowledge and more experience with the group before engaging in a fine grained analysis of subject matter teaching. One constraint with subject-matter mentoring may be that student-teachers must feel competent with whole-class management before going any further with their reflection.

Conclusion

It is too early to make any strong claims about the results of this study. More data are still to be gathered and analyzed. However, there are some tentative ideas and reflections we would like to put forward.

On the topic of practice, it would seem that subject-matter mentoring does not straightforwardly lead to better teaching this subject matter. Stages of student-teacher's development may impinge on their ability to understand and focus on subject matter. Moreover, student-teacher commitment to the learning-teaching experience, as well as the relationship with the mentor, remain important aspects of the practicum. When Josée scored level 3 teaching sequences, it was clear from the conversation transcripts that the mentor had contributed to the performance. However, it is not clear whether or not Josée only paid lip service acquiescence to the mentor's suggestions. Only data from the second and third year will help understand the extent of Josée's practice and learning. Secondly, however debatable the classification system might be, Josée's level of teaching demonstrates that level 1 sequences do not naïvely equate with; « bad teaching » or « low-level teaching ». Teaching at level 1 and 2 are important compulsory figures. Expertise in pedagogical-content knowledge does not mean that one does not teach at level 1 or level 2; it could mean however, that one is able to rapidly reach higher levels, 3 and 4, when the context is appropriate.

In terms of research, this study so far suggests that a classification system, that is meant to describe teaching practice, must take into account not only short units of teaching, but also the « intelligence » of the whole pedagogic segment. Secondly, any classification system stems from a « benchmark » which, in this case, still remains ambiguous or at least debatable; building a classification system from this ideal norm is fraught with difficulties. Classification systems, fragility of theoretical models for assessing expertise in mathematics teaching and difficulties that arise from trying to handle multiple, volatile contextual factors, are important limits of such a study.

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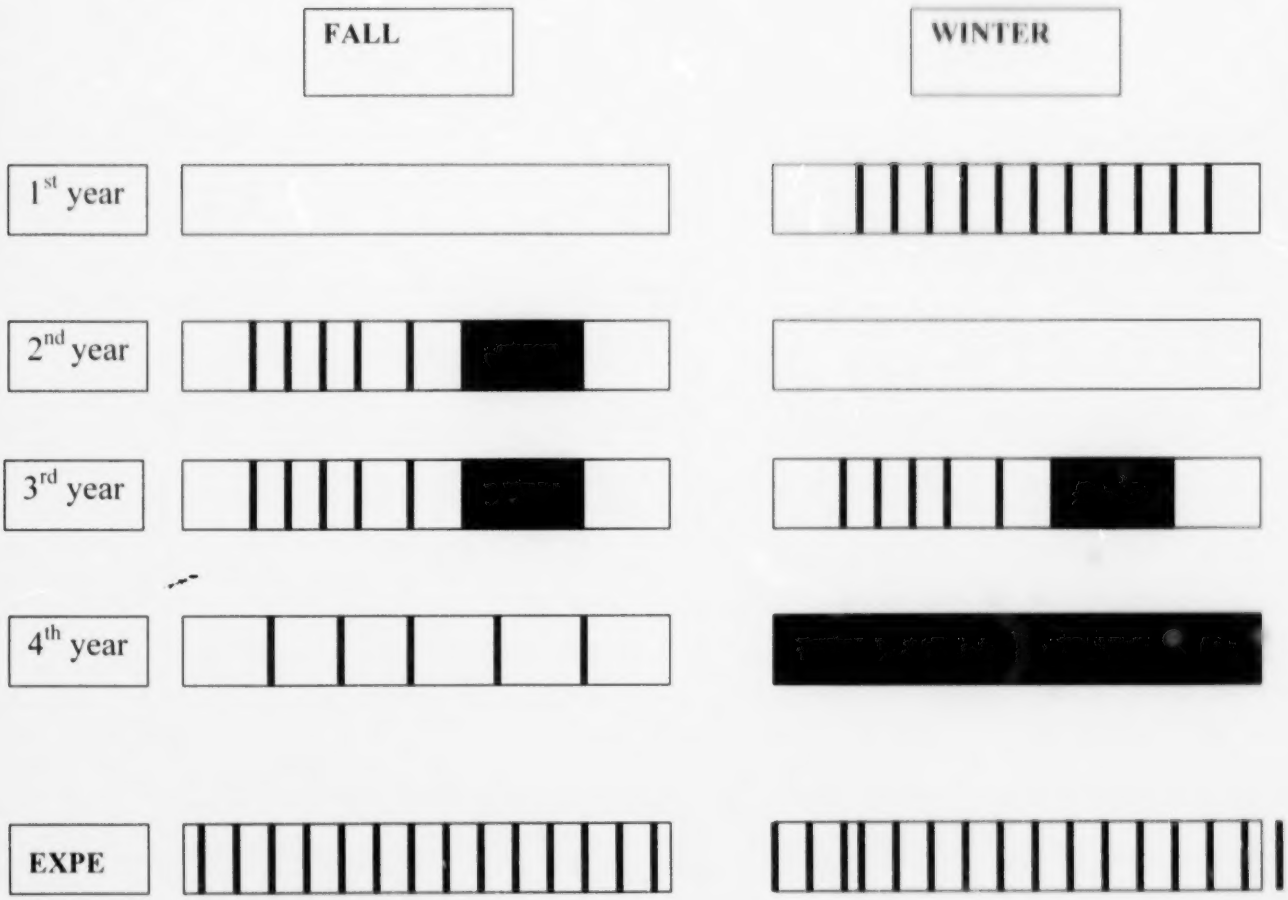
Appendice 1

FIELD PRACTICE SCHEDULE ACROSS THE 4 YEAR CURRICULUM



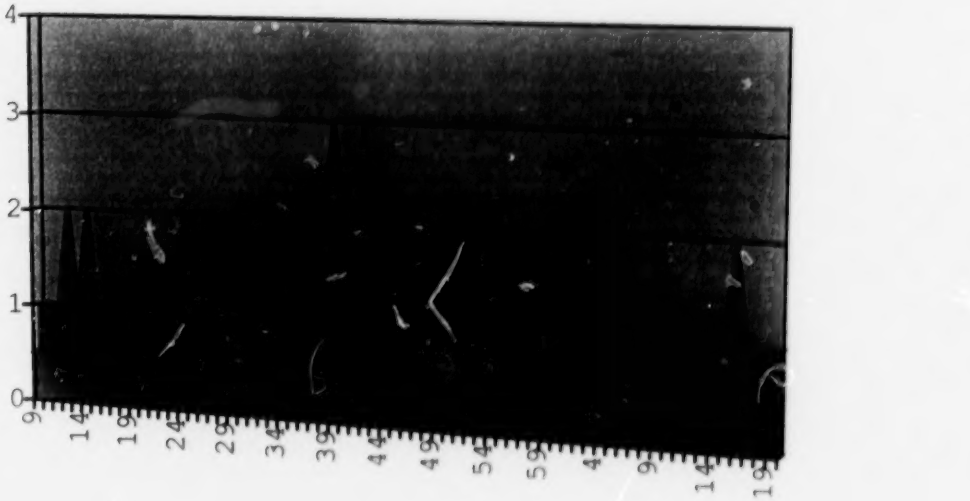
Appendice 2

Four levels of student-teacher practice
A provisional classification

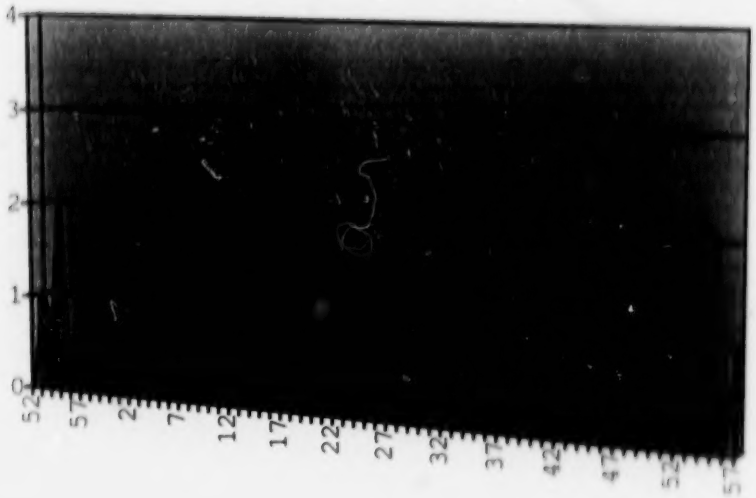
	Are concerned with the pupil's answers or questions	Check pupils' work or if they are following instruction. Stimulate work and involvement.	Introduce some content knowledge	Describe a task or a strategy.	
	Check understanding and make simple diagnosis. Underline knots about understanding of content.	Underline specific ideas, in order to put pupils back to work	Pace explanations in light of children's responses. Make links with prior knowledge or other activities	Monitor children's search for an appropriate strategy. Lend support in finding the strategy.	Help to elicit children's responses. Recognize difficulties.
	Assist children's own construction of knowledge. Provide conflicting ideas		Use children's experiences to make links. Question children about prior knowledge and understanding.	Help children to consider various strategies. Help them reflect about strategies used.	
	Adopt a chairperson's role in fostering thoughtful consideration of concepts		Choose appropriate analogies and metaphors.		

Appendice 3

Josée, Oct. 8/96 (Part 1)
Geometry



Josée, Feb. 12/97 (Part 1)
The maths challenge



Josée, April, 9,97; (Part2)
The Stock Exchange